INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 17, No. 1, p. 183-187, 2020

RESEARCH PAPER OPEN ACCESS

Germination potential of *Falcataria mollucana* (Miq.) Barneby & J.W. Grimes on different hot water pre-germination treatment and germination media

Kean Roe F. Mazo*[1,2], Rovana M. Jawani[1], Christian S. Tambac[1]

[1]*College of Forestry and Environmental Science, Central Mindanao University, Maramag, Bukidnon, Philippines*

[2]*Department of Forestry, Western Mindanao State University, Zamboanga City, Philippines*

Key words: *Falcata mollucana*, Germination media, Light conditions, Hot water treatment

http://dx.doi.org/10.12692/ijb/17.1.183-187 Article published on July 30, 2020

Abstract

The experiment was conducted to evaluate the germination potential of *Falcataria mollucana* (Miq.) Barneby & J.W. Grimes as affected by the length of time soaking in hot water, different germination media, and light conditions. The experiment was carried out using a three-factor in split-split plot design arranged in a randomized complete block design (RCDB) with three replications. Factor A was the soaking time of seeds (control, 20 seconds, 40 seconds, and 60 seconds), factor B was the germination media (soil and soil plus sand), and factor C was the light conditions (expose to light and expose to dark). Results indicated that soaking seeds in hot water increased the germination percentage. The highest significant increase was observed in seeds soaked for 20 seconds (71.67%). Likewise, seeds sown in soil and exposed to light are the best for seed germination, but no significant differences were observed. Interactions between germination media and light conditions did not influence the seed germination percentage of *F. mollucana*.

* **Corresponding Author:** Kean Roe F. Mazo ✉ keanmaze@gmail.com

Introduction

Falcataria moluccana (Miq.) Barneby & J.W.Grimes or commonly known as falcata is one of the preferred exotic tree species grown commercially due to its ability to grow faster in any variety of soils (Krisnawati, Varis, Kallio, & Kanninen, 2011) compared to other native species. FMB-DENR, (2014) reported that about 68% of the log production from plantation was from falcata. However, several falcata-based agroforestry systems and plantations were infected by genus *Uromycladium* causing gall rust (Doungsa-ard *et al.*, 2014; Lacandula, Rojo, Puno, & Casas, 2017; Palma *et al.*, 2020). In the Philippines and other countries in Southeast Asia, *F. mollucana* plays an important role in both commercial and traditional farming systems and expected to become increasingly important for wood and paper industries (Krisnawati *et al.*, 2011).

Physical dormancy is common in the seeds of the family Fabaceae (Elzenga & Bekker, 2016). Methods such as scarification, soaking in boiling water and the use of chemicals was practiced in some tree species to break this dormancy (Azad, Biswas & Matin, 2012; Farajollahi, Gholinejad & Jafari, 2014; Parrotta, 1990; Rupinta, Medina & Marin, 2020; Sajeevukumar, Sudhakara, Ashokan & Gopikumar, 1995; Soerianegara & Lemmens, 1993; Sudhakara, Kannan, Augustine & Ashokan, 1996). The choice of pre-germination treatments and growing media are imperative in nursery operations. Soil, sand, and mixtures of different organic materials are the most important and widely used media for propagation. Mariappan *et al.*, (2014) reported that the use of sand as a germination medium showed remarkable results in the germination of tree seeds.

Previous study on pre-germination treatment of falcata includes Parrotta, (1990), Soerianegara & Lemmens (1993), and Sajeevukumar *et al.*, (1995) which recommended the physical scarification and dipping of seeds in a hot water followed by soaking in cold water at varying time and temperature. More recently, Rupinta *et al.*, (2020) claimed that soaking the seeds for 30 seconds in hot water, followed by overnight soaking in tap water enhanced the germinative percentage, and suggested that the use of cloth was the best a germination media. The main objective of the present study is to evaluate the effective pre-germination time and locally available germination media of falcata seeds.

Material and methods

Study site

The study was conducted at the forest nursery of the College of Forestry and Environmental Science, Central Mindanao University, Maramag, Bukidnon. The nursery is managed by the University for its tree plantation.

Experimental Design

The experiment was carried out using a three-factor in split-split plot design arranged in a randomized complete block design (RCDB) with three replications. Factor A was the soaking time of seeds (control, 20 seconds, 40 seconds, and 60 seconds), factor B was the germination media (soil and soil plus sand), and factor C was the light conditions (expose to light and expose to dark).

Pre-germination Treatment & Germination Media

Viable seeds of falcata were soaked in boiling water (at constant temperature) for 20 seconds, 40 seconds, and 60 seconds. To avoid other sources of variation, a thermometer was used to ensure all seeds were soaked at the same temperature (100°C). Treated seeds were then transferred to the germination media. The germination media were 100% soil and 50% soil plus 50% sand. Ten (10) seeds per treatment were broadcast in the different germination media and a total of 480 seeds were used in the study. Watering was also done carefully and regularly.

Data Collection

Observations on the germination of seeds began from the first day and recorded daily by visual counting. When no additional germinations took place in 1 week, data recording was stopped. The duration of the experiment lasts for fifteen (15) days.

Statistical Analysis

Statistical Tool for Agricultural Research (STAR) 2.0.1 software was used for the analysis of variance (ANOVA).

Tukey's Honest Significant Difference Test at $p<0.05$. was performed to compare treatment means. Germination of seed was calculated using the formula:

$$\% \text{ Germination} = \frac{TG}{TS} \times 100$$

Where,

TG = total seeds germinated

TS = total seed sown

Results and discussion

Percent Germination

The seed germination of falcata seeds soaked in different time lengths in different media under varying light conditions began on the third day after sowing. Different soaking time of seed in hot water (100°C) showed different effects on the germination percentage. Seeds soaked for 20 seconds had significantly higher germination percentage (71.67%), but no significant difference was observed between seed soaked for 20, 40, and 60 seconds (Fig. 1). The results further showed that soaking seeds for 20 seconds increased by 58% than to those in control. The mean germination percentage of *F. mollucana* significantly decreased as the length of soaking time increases.

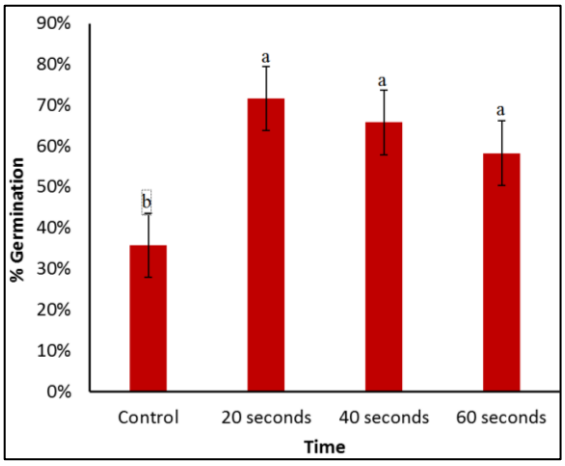

Fig. 1. Mean germination percentage after hot water pretreatment. Error bars represent the standard error. Bars with the same letter are not significantly different at $p<0.05$.

In other species of the same family like *Cassia fistula*, soaking seed up to 6 mins enhanced seed germination (Soliman & Abbas, 2013). Similar results obtained from the experiment of the same species by Rupinta *et al.*, (2020) that seeds soaked for 30 seconds in hot water increased germination percentage and a shorter period of soaking time resulted to a significantly lower germination percentage. Azad *et al.*, (2012), also reported that on the seed germination of *Albizia procera* (Roxb) Benth that immersion of seeds in hot water at 80°C for 10 minutes performed significantly better compared to other treatments. Hot water treatments significantly increased germination in *Albizia* species was also observed by Sajeevukumar *et al.*, (1995). The length of soaking time in hot water is significantly influenced germination and clearly shows that falcata seeds have an optimum length of soaking time in hot water to achieve a higher germination percentage based on the study.

Effect of germination media and light conditions on germination percentage

The effect of germination percentage on germination media and light condition are shown in Table 1. The results showed that the highest germination percentage was observed in seeds sown in soil (60.4%), while 55.4% for soil plus sand. Analysis of variance showed no significant difference between germination media.

On the other hand, seeds exposed to light germinated quite better (60.0%) compared to those seeds exposed to dark, but no statistically significant difference. The result is supported by the study of Domingo (1983) reported that germination of falcata seeds is not affected by light or dark periods. Flores *et al.*, (2016) classified plants based on their responses to light germination. The results suggest that falcata seeds are neutral to light. According to Fenner & Thompson, (2005), it is more complex to recognize the specific light preference of many species.

Table 1. Mean germination percentage on germination media and light condition.

Factors		% Germination
Germination Media	Soil	60.4%
	Soil + sand	55.4%
Light Conditions	light	60.0%
	dark	55.8%
p-value	ns	ns

ns=not significant; *=significant at $p<0.05$

All interactions did not show significant effect on the seed germination of *F. mollucana* (Table 2). This shows that the germination media and light condition does not influence the germination capacity of the seeds. The germination of seeds requires a certain niched-specific condition that is species dependent (Elzenga & Bekker, 2016). The results obtained did not support Munjuga *et al*., (2013) that light soil or sand was the best media for germination. Falcata seeds germinate readily in 2 to 10 days, provided there is sufficient soil moisture (Yap & Wong, 1983), and plays a significant role during germination through enzyme activation, breakdown, translocation, and use of reserve storage material (Shaban, 2013).

Table 2. Interactions between factors.

Interactions	p value
Germination media x light conditions	0.0811^{ns}
Germination media x Soaking time	0.0579^{ns}
light conditions x Soaking time	0.1757^{ns}
germination media x light conditions x Soaking time	0.3330^{ns}

ns=not significant; *=significant at $p<0.05$

Conclusion and recommendation

Soaking seeds to hot water prior to sowing proved to be effective in breaking the seed dormancy of *F. mollucana* and significantly increased germination percentage. Among the pre-treatments, seed soaked in hot water for 20 minutes gave the best germination results. In contrast, the use of soil and sand plus soil as germination media and light conditions did not affect the germination percentage. Thus, soaking falcata seeds in hot water for 20 minutes before seed sowing and testing other combinations of gemination media is hereby recommended.

Acknowledgments

Special thanks to the Department of Science and Technology (DOST) for financial support. Also, to the Central Mindanao University, College of Forestry and Environmental Science for the use of nursery during the experiment.

References

Azad S, Biswas RK, Matin A. 2012. Seed germination of *Albizia procera* (Roxb.) Benth . in Bangladesh : a basis for seed source variation and pre-sowing treatment effect. Forestry Studies in China **14(2),** 124-130.

Domingo I. 1983**.** Germination of falcata seeds under various light conditions. FRD Technical Report.

Doungsa-ard C, Mctaggart AR, Geering AD, Dalisay TU, Ray J, Shivas RG. 2014. *Uromycladium falcatarium* sp. nov ., the cause of gall rust on Paraserianthes falcataria in south-east Asia. Australasian Plant Pathology 1-6. https://doi.org/10.1007/s13313-014-0301-z

E**lzenga JTM, Bekker RM.** 2016. Seed germination : ecological aspects – special issue editorial. Plant Biology **19,** 3-5. https://doi.org/10.1111/plb.12522

Farajollahi A, Gholinejad B, Jafari HJ. 2014. Effects of Different Treatments on Seed Germination Improvement of Calotropis persica. Hindawi Publishing Corporation Advances in Agriculture 1-6. https://doi.org/http://dx.doi.org/10.1155/2014/245686

Fenner M, Thompson K. 2005. The Ecology of Seeds. Cambridge, UK : Cambridge University Press.

Flores J, González-Salvatierra C, Jurado E. 2016. Effect of light on seed germination and seedling shape of succulent species from Mexico. Journal of Plant Ecology **9(2),** 174-179. https://doi.org/org /10.1093/jpe/rtv046

FMB-DENR. 2014**.** Forest Management Bureau-Department of Environment and Natural Resources Philippine Forestry Statistics. Diliman, Quezon City.

Krisnawati H, Varis E, Kallio M, Kanninen M. 2011. *Paraserianthes falcataria* (L.) Nielsen: Ecology, silviculture, and productivity. Center for International Forestry Research.

Lacandula LF, Rojo MJA, Puno GR, Casas JV. 2017. Geospatial analysis on the influence of biophysical factors on the gall rust prevalence in falcata (*Paraserianthes falcataria* L . Nielsen) plantation in Gingoog City, Philippines. Journal of Biodiversity and Environmental Sciences **11(4),** 18-24.

Mariappan N, Srimathi P, Sundaramoorthi L, Sudhakar K. 2014. Effect of growing media on seed germination and vigor in biofuel tree species. Journal of Forest Research. https://doi.org/10.1007/s11676-014-0484-8

Munjuga M, Gachuiri A, Ofori D, Mpanda M, Muriuki J, Jamnadass R, Mowo J. 2013. Nursery management, tree propagation, and marketing: A training manual for smallholder farmers and nursery operators. World Agroforestry Centre.

P**alma RA, Tiongco LE, Canencia OP, Bonia RD, Florida EJ, Dagonio JY.** 2020. Gall rust disease incidence of Falcata (*Paraserianthes falcataria* (L.) Nielsen) in Falcata - based agroforestry systems in Misamis Oriental. IOP Conf. Series: Earth and Environmental Science **449.** https://doi.org/10.1088/1755-1315/449/1/012035

Parrotta JA. 1990. *Paraserianthes falcataria* (L.) Nielsen. Silvics of forestry trees of the American tropics. SO-ITF-SM-31. Forest Service, USDA, Rio Piedras, Puerto Rico.

Rupinta NM, Medina AMP, Marin RA. 2020**.** Effects of different hot water pre-germination treatment and germination media on the germination of Falcata (*Falcataria moluccana,* (Miq.) Barneby and J.W. Grimes). International Journal of Biosciences **2020(2),** 130-136. https://doi.org/10.12692/ijb/16.2.130-136

Sajeevukumar B, Sudhakara K, Ashokan P, Gopikumar K. 1995. Seed dormancy and germination in *Albizia falcataria* and *Albizia procera*. Journal of Tropical Forest Science **7(3),** 371-382.

Shaban M. 2013. Effect of water and temperature on seed germination and emergence as a seed hydrothermal time model. International Journal of Advanced Biological and Biomedical Research **1(12),** 1686-1691.

Soerianegara I, Lemmens RH. 1993. Timber trees: Major commercial timbers. Plant Resources in Southeast Asia **5(1).**

Soliman A, Abbas M. 2013. Effects of Sulfuric Acid and Hot Water Pre-Treatments on Seed Germination and Seedlings Growth of *Cassia fistula* L. American-Eurasian Journal of Agriculture & Environmental Science **13,** 7-15.

Sudhakara K, Kannan CS, Augustine A, Ashokan PK. 1996. Seed dormancy and pre-treatments to enhance germination in selected *Albizia* species. Journal of Tropical Forest Science **8(3),** 369-380.

Yap SK, Wong SM. 1983. Seed biology of Acacia mangium, Albizia falcataria, Eucalyptus spp., Gmelina arborea, Maesopsis eminii, Pinus caribaea and Tectona grandis. Malaysian Forester **46(1),** 26-45.